



Pests of Grain Crops

ISSUED BY THE
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
RALEIGH, N. C.

BULLETIN No. 128



JULY 1, 1896.

445

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

INCLUDING

THE FERTILIZER CONTROL STATION

AND THE STATE WEATHER SERVICE,

UNDER THE CONTROL OF THE

N. C. STATE BOARD OF AGRICULTURE.

W. F. GREEN, *Chairman*, Franklinton.

W. S. PRIMROSE	Raleigh	J. H. GILMER	Greensboro.
D. A. TOMPKINS	Charlotte.	J. R. MCLELLAND	Mooreville.
H. E. FRIES	Salem.	CYRUS THOMPSON	Richlands.
N. B. BROUGHTON	Raleigh.	H. E. KING	Peanut.
R. W. WHARTON	Washington.	E. A. AIKEN	Jeptha.
J. B. COFFIELD	Everett's.	J. L. NELSON	Lenoir.
W. R. CAPEHART	Avoca.	FRANK WOOD	Edenton.

STAFF OF THE EXPERIMENT STATION.

H. B. BATTLE, PH. D.	Director and State Chemist.
F. E. EMERY, M. S.	Agriculturist.
GERALD MCCARTHY, B. SC.	Botanist and Entomologist.
W. F. MASSEY, C. E.	Horticulturist.
C. F. VON HERRMANN (U. S. Weather Bureau)	Meteorologist.
F. E. HEGE	Poultry Manager.
F. P. WILLIAMSON, D. V. S.	Consulting Veterinarian.
B. W. KILGORE, M. S.	Assistant Chemist.
W. M. ALLEN	Assistant Chemist.
C. B. WILLIAMS, B. S.	Assistant Chemist.
H. K. MILLER, M. S.	Assistant Chemist.
S. E. ASBURY, B. S.	Assistant Chemist.
ALEXANDER RHODES	Assistant Horticulturist.
ROSCOE NUNN (U. S. Weather Bureau)	Assistant Meteorologist.
A. F. BOWEN	Secretary.

RALEIGH, N. C.

TABLE OF CONTENTS.

PESTS OF GRAIN CROPS.	PAGE.
Fungicides	148
Insecticides	149
Pests of barley	150
Pests of buckwheat	151
Pests of Indian corn	151
Pests of millet	153
Pests of oats	153
Pests of rice	153
Pests of rye	153
Pests of sorghum	154
Pests of wheat	154

PESTS OF GRAIN CROPS.

BY GERALD MCCARTHY, BOTANIST AND ENTOMOLOGIST.

The damages caused by rusts and smuts of cereal grains amount to several millions of dollars annually for the whole country, and for North Carolina probably not less than \$50,000. A good proportion of this sum may be saved by following the treatments advised in this Bulletin. The worst of these pests are the Stinking Smut of wheat, the Loose Smut of oats, and the Black Smut of corn. The rusts which cause the red or black lines in the leaves and stems of grain plants, do more or less damage, but for these no practicable remedy is known. But by rotating crops and keeping fields clean, losses from this source will be light. The smuts are most abundant during cool and moist weather, and upon moist soils; the rusts, on the other hand, are worst upon dry soils and in hot dry weather. The damage annually caused to grain growers by insects, is better understood than in the case of fungous pests. Its amount equals or exceeds that caused by fungi.

In preparing and using the fungicides and insecticides herein recommended, great care must be taken to use only the amounts specified, in the way described, and for the given purpose. Of course proportionate parts of the formulas may be used if desired. To disregard the caution, or use mere guess work, will be worse than leaving the matter alone. We advise, for treating seed grains, formulas Nos. 1 and 2, rather than No. 3. The latter is cheap and always at hand, but without great care and a good thermometer, the correct degree of heat cannot be had.

Fungicides.

No. 1.—Copper sulphate (bluestone) 1 pound.
Water (hot or cold) 25 gallons or $\frac{1}{2}$ barrel.

Directions: Dissolve the bluestone, which should be pulverized, in the water by suspending it in a thin or coarse sack until dissolved. It is then ready to use.

To treat the seed: Pour seed into a wooden barrel or tub, and add enough of above solution to cover. Let stand for 10 or 12 hours—not longer; then remove and sprinkle with sufficient air-slaked lime to dry. For wheat and rye seed only.

No. 2.—Potassium sulphide (Liver of sulphur) 2 pounds.
Water 25 gallons or $\frac{1}{2}$ barrel.

Directions: Dissolve the liver of sulphur in the water. It is then ready to use.

To treat the seed: Pour seed into a barrel or tub and add enough of above solution to cover. Let stand for 12 to 15 hours, stirring occasionally. Remove, and dry in air, or sow at once. For oats only.

No. 3.—Hot water, 120° F. to 125° F.	Sufficient quantity (Vessel No. 1)
Hot water, 132° F. to 135° F.	Sufficient quantity (Vessel No. 2)
Cold water.....	Sufficient quantity (Vessel No. 3)

Directions: Have three tubs, or suitable vessels, for the different waters. Place seed to be treated in a gunny or burlap sack and plunge for 2 or 3 minutes into vessel No. 1. Remove and quickly plunge into No. 2 for 10 minutes, constantly shaking or twisting the sack. Remove at once, plunge into No. 3 until seed is cooled. Then spread out to dry, or sprinkle on enough air-slaked lime to dry, or sow the seed at once without drying. Do not guess at temperature. Use a good thermometer, or else do not attempt this treatment. For all kinds of grain. May be used in place of Nos. 1 and 2.

Insecticides.

NO. 4.—KEROSENE EMULSION.

Bar soap.....	$\frac{1}{2}$ pound.
Boiling water.....	1 gallon.
Kerosene.....	2 gallons.

Directions: Dissolve the soap in the water, add the kerosene, and pass through a spraying pump 2 or 3 times. In making up a small quantity, a tin egg churn may be used. Dilute 15 times before using.

NOTE.—The kerosene emulsion must be *thoroughly* made or it will burn the plants. For sucking insects and worms.

NO. 5.—TOBACCO DECOCTION.

Tobacco dust, or powdered leaves.....	1 pound.
Water.....	3 gallons.

Directions: Boil the tobacco in water for 1 hour, or steep in boiling water over night. Replace the evaporated water and use without further dilution. For soft-bodied insects.

NO. 6.—PARIS GREEN (WET).

Paris green.....	3 to 4 ounces.
Water or Bordeaux mixture.....	1 barrel.

Directions: If water is used, always add 1 pound quick lime to each barrellful. For use against gnawing insects, e. g. potato beetle.

NO. 7.—PARIS GREEN (DRY).

Paris green.....	1 pound.
Air-slaked lime or plaster paris.....	30 pounds.

Directions: Mix well, and use dry. For gnawing insects.

[NO. 8.—CARBOLIZED LIME.

Air-slaked lime	30 pounds.
Crude carbolic acid	1 quart.

Directions: Mix well and use as a powder. For root-gnawing insects and plant lice.

NO. 9.—ARSENIC BAIT.

White arsenic	1 pound.
(Or Paris green	2 pounds).
Sugar	1 pound.
Wheat bran or cotton seed meal	25 pounds.

Directions: Mix well; add enough water to make a sticky mass. Use as a bait for grasshoppers and cut worms.

NO. 10.—CARBON BISULPHIDE.

Directions: Use pure, in a tight vessel or room, and handle carefully away from fire or a light, as it is explosive. For weevils.

NO. 11.—RAT POISON.

White arsenic	1 ounce.
Freshly toasted cheese	1 pound.

Directions: Sprinkle arsenic on toasted cheese; wrap whole in a thin paper bag and place where rats or mice can get at it. Renew bait with fresh material every evening.

NO. 12.—RAT POISON.

Sweet corn or freshly roasted peanuts ground to a coarse meal...	$\frac{1}{2}$ pound.
Plaster paris	$\frac{1}{2}$ pound.

Directions: Mix the meal and plaster dry, and set where rats or mice can get it.

Pests of Barley.

Principal Fungous Diseases. 1. Rust: Caused by *Puccinia coronata*. Color, red; shape linear; on stems and leaves. Remedy: none.

2. Smut: Caused by *Ustilago*, sp. On seed. Remedy: Nos. 1 or 3.

Principal Insect Pests. 1. Army worm (*Lucania unipuncta*), about $1\frac{1}{2}$ inch long, blackish with yellow stripes. Appears in spring and early summer and eats the whole plant. Remedy: Cut and cure badly infested fields. Ditch worms out of threatened fields. Spray kerosene emulsion, Formula 4, on them, or use pure kerosene and set fire to it.

2. Grass worms (*Laphygma frugiperda*), resembles army worm and is generally confused with it. Appears in spring and early summer. Remedy: same as for army worm.

3. Chinch Bug (*Blissus leucopterus*). About $\frac{1}{2}$ inch long when mature. Black with white wings. Young are wingless and red or yellowish. The bug punctures the whole plant, more especially the

roots, and sucks the sap. Does not chew or gnaw. Remedies: (a) Before plowing, burn over fields where small grain is to be sown, also fence corners and hedge-rows. Best done during early winter; (b) Ditch insects out. (See under wheat); (c) If crop is badly attacked, cut and cure at once and plow and roll ground, then sow to peas—not grain or grass.

4. Grasshoppers (*Melanoplus femur-rubrum*) and other species. About one inch long, with glossy red legs. Attacks whole plant. Remedy: Arsenical bait, Formula No. 9. Place a tablespoonful at intervals of four feet or so throughout field.

Pests of Buckwheat.

Principal Fungous Disease. 1. Smut (*Ramularia*, sp.) Attacks leaf. Remedy: None.

Principal Insect Pests. 1. Wire-worms attack seed and roots. Remedy: (a) Arsenical bait; (b) Free use of kainit on land; (c) hand picking; (d) Keep field free from rotten wood.

Pests of Indian Corn.

Principal Fungous Diseases. 1. Smut (*Ustilago maydis*). Attacks ears. Remedies: Rotation of crops. Removal and destruction of smutted ears as soon as noticed.

2. Rust (*Puccinia sorghi*), attacks leaves, producing red and black lines. Remedy: None.

Principal Insect Pests. 1. Boll-bud or corn worm (*Heliothis armigera*). About 1½ inch long, striped. Attacks leaves, buds and ears. Also attacks cotton bolls. Remedies: (a) Paris green on leaves before plants form buds; (b) Hand-pick from ears; (c) Fall plowing.

2. Curlew beetle or Bill-beetle (*Sphenophorus sculptilis*). One-fourth inch long, ash-gray, with long snout. Bore into base of young plants. Troublesome only on low grounds infested by sedges, reeds and rotten wood. Remedies: (a) Plant corn only on upland, or keep low fields free from rotten wood and sedges; (b) Hand-pick from plants; (d) Do not allow corn stumps or stalks to remain on ground during winter.

3. Cut Worms. (*Agrotis telifera*, and other species.) About 1½ inch long, fat and sluggish. They cut off young plants at surface of ground. Remedies: (a) Arsenical bait, Formula No. 9, made into balls with moist clover and other succulent vegetables. Place at intervals of 2 yards throughout field a few days before corn is planted. Keep the balls moist. (b) Hand pick worms. (c) Plant enough seed to allow plants for cut worms and still leave a good stand. (d) Use kainit freely in hill or drill.

4. Wire Worms. (*Drasterius dorsalis*, and several other species.) About 1 to 1½ inches long, flattish, horny. Attack seed in ground. Remedies: (a) Fall plowing. (b) Rapidly repeated cultivation of crop. (c) Free use of kainit in hill or drill. (d) Formula No. 9, as

for grasshoppers. (e) Keep land free from rotten wood and old stalks and stumps.

5. Corn root worm or Bud worm. (*Diabrotica duodecimpunctata*.) Mature insect is yellowish green, with 12 black spots on wings. Mature worm very slender, about $\frac{1}{2}$ inch long. Feeds upon the roots and base of stalk of young plants. Remedies: (a) Hand pick from roots. (b) Dust on young plants a mixture of Paris green, and air-slaked lime. Formula No. 7. (c) Use No. 8 about the roots.

6. Army worm. (*Lucania unipuncta*.) A large, fat, striped worm, usually found in troops, hence the name, Army worm. Remedies: (a) Ditch out of fields as recommended for chinch bugs. See page 4. (b) Dust or spray plants with Paris green Formulas Nos. 6 and 7. (c) Spray the worms while on the ground with kerosene emulsion, Formula No. 4, or use pure kerosene and set fire to it. (d) Fall plowing, to destroy the dormant pupæ in the ground.

7. Chinch Bug. (*Blissus leucopterus*.) A small, black, white-winged, insect, or when young red and wingless, with a bed-bug like odor. Remedies: (a) Ditching out of field. See under wheat. (b) Spray with No. 4, or use pure kerosene and fire. (d) Keep fields free from trash, which shelter the insects during the winter. This insect is troublesome only during unusually dry seasons. Wet weather is fatal to it.

8. Grasshoppers. (*Melanoplus femur-rubrum*, and other species. Two species are more or less injurious in North Carolina. Remedies: (a) Poisoned bait, Formula No. 9. Place a teaspoonful near every second or third plant in drill, or at each hill.

9. Fly or Angoumois weevil. (*Gelechia cerealella*.) A slender moth which lay its eggs in matured corn in crib or granary. Remedy: (a) Carbon bisulphide in closed bins or rooms. Use about two pounds per ton of grain, or in close rooms or bins use one pound for each 10 cubic feet of space. Place the substance in saucers or shallow dishes near top of pile or room. Close room as tightly as possible and let remain closed for 48 hours. Then open, and freely admit air. Beware of taking a light or fire into the room while the peculiar odor of the substance can be smelled. (b) In granaries and cribs a lamp or lantern set over a tub containing water and a thin film of kerosene oil, will destroy vast numbers of the moths, but will not kill the worms in the grain.

10. Granary weevil. (*Calandra granarius* and *C. oryza*.) A very small, slender, dark-brown or black beetle. Infests granaries and store-rooms. Remedies: (a) Carbon bisulphide as for No. 9. (b) Saturate with melted lard sheets of brown paper. Dust a little Paris green or white arsenic on these, and lay them on floor or shelves of rooms infected by these weevils.

11. Meal worm. (*Tenebrio molitor*.) This worm is about 1 inch long, and resembles a wire worm. The parent beetle is black, and about $\frac{1}{2}$ inch long. Infests granaries and store-rooms. Remedies: Same as for No. 9.

12. Rats and mice. These animals infest granaries, &c. Remedies: (a) Carbon bisulphide as for weevils; (b) "Champion-liar" trap; (c) cats; (d) Poisons, Formulas Nos. 11-12.

Pests of Millet.

Principal Fungous Diseases. Rust. (*Puccinia rubigo-vera*). Remedies: None.

Principal Insect Pests. 1. Chinch bug (*Blissus leucopterus*). Remedies: (a) Mow field as soon as attacked; remove hay as soon as possible and fire stubble, first sprinkling some kerosene or straw on it to insure a hot fire; (b) Ditch the bugs out as recommended for wheat. The chinch bug prefers millet to any other plant, and this crop is, therefore, often used to attract the bug, and when the bugs are thick on it, the trap crop is fired.

2. Army worm (*Lucania unipuncta*). Remedies: Same as for chinch bugs.

3. Grasshoppers (*Melanoplus* species). Remedies: Poisoned bait. Formula No. 9. A tablespoonful for every square yard through the field.

4. Plant lice (*Siphonaptera avena*). See under wheat.

Pests of Oats.

Principal Fungous Diseases. 1. Rust (*Puccinia coronata*). Remedies: (a), Sowing only rust-proof varieties; (b) Early fall planting. Rust is a disease of warm, dry climates, and in the South this crop must be grown during the colder months of the year. It is perfectly hardy in winter.

2. Loose smut (*Ustilago avenæ*). Appears as a black powder among the seeds, often wholly replacing the grain in the husks. Remedies: Only preventive treatment practicable: (a) Soak seed before planting for 10 or 12 hours in a tub or barrel, using formulas Nos. 2 or 3, sufficient to completely cover the grain.

Principal Insect Pests. Chinch bug, army worm, grasshoppers, plant lice. Remedies: See under heads of corn, millet and wheat.

Pests of Rice.

Principal Fungous Diseases. 1. Rust (*Puccinia* sp). Remedies: None.

Principal Insect Pests. 1. Rice weevil (*Calandra oryza*). Remedies: (a) Same as for corn weevil. 2. Grasshoppers: Remedy: (a) Poisoned bait on embankments; (b) Flowing field with water.

Pests of Rye.

Principal Fungous Diseases. 1. Ergot (*Claviceps purpurea*) appears on seed heads as black, cock-spur like forms. Remedies: (a) Soak seed before planting for 10 or 12 hours in copper sulphate, Formula

No. 1; (b) Mow crop as soon as seed heads begin to show above their sheaths. Rye is usually grown for forage in the South, and should be cut as soon as the seed tops show; a second cutting can then be secured. Ergot does not develop in the stems or leaves.

2. Rust. (*Puccinia coronata*.) Appears as long, slender, red or black spots on leaves and stems. Remedies: Sow early in fall and cut before the weather gets too warm.

Principal Insect Pests. 1. Chinch bug, army worm, grasshoppers, fly weevil, grain weevil. Remedies: Same as prescribed for corn and millet.

Pests of Sorghum.

Principal Fungous Diseases. 1. Rust. (*Puccinia sorghi*.) Remedies: None. The disease is of little importance.

Principal Insect Pests. Army worm, grasshoppers, chinch bug, fly weevil, grain weevil, plant lice. Remedies: Same as prescribed in case of corn and millet and wheat.

Pests of Wheat.

Principal Fungous Diseases. 1. Stinking smut. (*Tilletia tritici*.) Appears on seed heads and on seeds as badly smelling black powder. Remedies: (a) Soak seed before planting for 10 or 12 hours in copper sulphate, Formula No. 1, or use hot water, Formula No. 3, as directed.

2. Loose smut. (*Ustilago tritici*.) Much like No. 9, but without its peculiar odor. Much less common and destructive. Remedies: Bluestone, Formula No. 1.

3. Rust. (*Puccinia rubigo-vera*.) Appears as slender, red or black spots on leaves and stems. Remedies: (a) Sow only "Rust-proof" varieties. Hard, smooth, red wheats are least liable to disease and insect attacks.

Principal Insect Pests. 1. Army worm, grasshoppers, fly weevil, grain weevil, Hessian fly, grain louse, chinch bug. Remedies: For all, except the last three, see under corn and millet.

1. Hessian fly. (*Cecidomyia destructor*.) A small, brown, mosquito-like fly. Lays her eggs in young plants, near the ground, both in fall and spring. The grubs form galls at the base of the plants and absorb the sap that should go to develop the plant. This insect causes more damage to wheat growers than all other insects combined. Remedies: (a) Sow main crop as late as possible. (b) Two or three weeks before main crop sow around the field a narrow strip of some early wheat as a trap-crop. As soon as main crop has broken ground, plow the trap-crop under as deeply as possible and roll hard. For main crop, sow only hard, red wheat. For trap-crop, sow soft, white wheat. (c) As soon as crop is harvested, burn the stubble, or better, plow it under as deeply as possible, and sow land broadcast with cowpeas. Roll hard. (d) Use kainit freely in

manuring land for wheat. (e) Burn all screenings and dust from the threshing machine, as these contain numerous eggs of the fly.

2. Grain louse. (*Siphonophora avena*.) A large, brown or green louse, which attacks the ripening seeds. Remedies: (a) Spray the plants with Formulas Nos. 4 or 5. Or dust with air-slaked lime and crude carbolic acid, Formula No. 8.

3. Chinch bug. (*Blissus leucopterus*.) This, next to the Hessian fly, is the greatest pest of wheat. Remedy: The only trustworthy method of fighting chinch bugs is by ditching them in or out of a field. With a two-horse plow make a deep furrow around the field to be protected, with the landslide towards this field. In the furrow at intervals of eight or ten feet dig deep holes. The bugs in attempting to pass will fall into the ditch and fill the holes. Then they may be crushed by dragging a heavy log in the furrow, or another furrow, still on the side towards the protected field, may be plowed upon the bugs and rolled or stamped hard. Repeat as often as necessary. If such a furrow cannot be made, a board six to twelve inches wide set upon edge around the field will act as an effectual barrier, if the upper edge is kept covered with liquid tar.

Chinch bugs always attack wheat first, and when this is eaten, start for the nearest corn field or timothy meadow. If they get into a corn field, cut at once the rows infected by bugs, and ditch around the rest of the field as above directed. The corn cut may be used as fodder, as the bugs will leave it as soon as it is dry. Small grain or grass may be saved by cutting and curing at once, but it will not pay to try to destroy the bugs in a standing crop. Chinch bugs do not injure cowpeas, and these may be sown on a field which has been recently infested by the bugs. Chinch bugs are never dangerous except during dry seasons and upon dry land. Wet weather soon develops contagious disease among these insects, which sweeps them off. The germs of these diseases may be artificially propagated and introduced into fields infested by chinch bugs, but unless the weather is favorable the disease will not spread. The germs of these diseases are generally present wherever the bugs are found. Therefore no reliance can be placed upon artificially introduced infectious diseases for destroying chinch bugs.

